Revue suisse de Zoologie, vol. hors série: 61-70; août 1996

Preliminary results on the colonization of a newly planted hedgerow by epigeic spiders (Araneae) under the influence of adjacent cereal fields

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Preliminary results on the colonization of a newly planted hedgerow by epigeic spiders (Araneae) under the influence of adjacent cereal fields. - This paper presents preliminary results on the colonization of a newly planted hedgerow in an intensively cultivated area of Upper Austria. The hedgerow with successional shrubs and trees is subdivided into four sections, which are separated by fallow arable land. Investigations were carried out with pitfall traps in two of the sections with adjacent cereal fields. The aim was to find out if there were already differences between the center and both edges of the hedgerow concerning the epigeic fauna of spiders in the first year after plantation. Significant differences could be found in spider activity.

Key-words: Araneae - epigeic spiders - colonization - hedgerow - cereal fields.

INTRODUCTION

In the agricultural landscape hedgerows and field shrubs can either be important habitats for a lot of endangered plant and animal species or overwintering sites as well as corridors for migrating animals (e.g. Tischler 1951, Streeter *et al.* 1984).

After years of service hedgerows have been in decline in most parts of Europe to increase farming acreage. Although the rate of removal has slowed, because of the knowledge of their benefit (e.g. Nägeli 1943; Tüxen 1952; Schelhorn 1982; Reif *et al.* 1995), Austrian farmers still do not make much effort in planting new ones due to minimal financial subsidies.

Several papers about faunistic observations on arachnids in hedgerows and adjacent areas have been published (Tischler 1958; Bliss *et al.* 1981; Nährig 1987, 1991*a*, *b*; Blick 1988, 1990, 1991) but only few studies investigated the colonization dynamics in such habitat types (Spreier 1984; Zwölfer *et al.* 1984; Mader 1986; Lechner 1991; Gruttke & Willecke 1993). However, none of the last-named deals with spider species characteristics.

Manuscript accepted 19.01.1996.
Proceedings of the XIIIth International Congress of Arachnology, Geneva, 3-8.IX.1995.

This paper presents preliminary results of investigations on the colonization of a hedgerow by epigeic spiders within the first year after the plantation (BERGTHALER 1996). Pitfall trapping continues and a long-term study including observations in higher strata will be conducted.

STUDY AREA AND METHODS

The hedgerow was planted in autumn 1992 and is surrounded by an intensively cultivated area in the diluvial terrace region north of the Alps (Schwand im Innkreis, Upper Austria, 420 m a.s.l.). It is situated in a climatically favoured area with about 220 days/year of daily temperatures higher than 5°C on an average and about 25 days/year with more than 10 mm precipitation (PILS 1994). Although the annual precipitation comes up only to 850 mm the loamy soil provides high humidity in the lower strata.

The hedgerow covers about 1400 m^2 and is subdivided into four sections, each 3.5 m wide. They are separated by fallow arable land and vary in length as well as the type of adjacent cultivations and the density of vegetation. Investigations in two of the sections (A: 30 m; B: 100 m in length) with adjacent cereal fields were carried out between 9th April 1993 and 6th January 1994 (10 catching periods; phenological data will be published separately). The vegetation was almost as dense in section A (one plant / 1.8 m^2) as in section B (one plant /1.5 m^2). About 10% of the plants in each of the two sections were 150 - 400 cm high and the rest was below 150 cm in height. 18 pitfall traps - filled to 1/3 of the volume (ø 9 cm, 400 ml) with 4% formalin solution (detergent added as a surfactant), were disposed in 3 rows of 6 (Fig. 1). The pitfall traps in row 1 were situated at the edge of the hedgerow close to spring oat (*Avena sativa*), the ones of row 2 in the center, and the pitfall traps of row 3 at the edge close to winter barley (*Hordeum vulgare*).

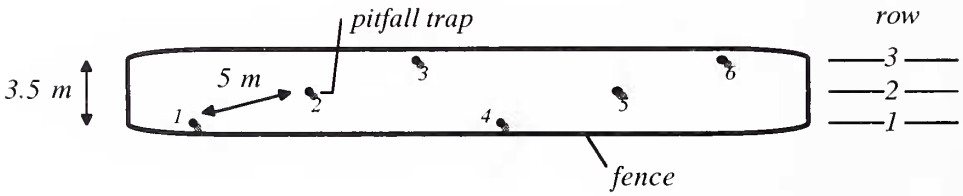

FIG. 1

Schematic illustration of the distribution of pitfall traps as for instance in section A. 12 traps were used in section B. Each section is fenced in to keep rabbits and deer from destroying the plantation.

At the beginning of the trapping period winter barley was already about 10 cm high, whilst spring oat had only reached the soil surface. The ground of the hedgerow was only sparsely vegetated (ground covered up to 25%). In mid of May winter barley

already had its ears and the height of the herbaceous stratum within the hedgerow (ground covered at least to 75%) was similar to the spring oat field, which began to develop its ears. At the begining of June both weeds of the adjacent winter barley field *Tripleurospermum inodorum* (Asteraceae) and *Apera spica-venti* (Poaceae) began to dominate within the hedgerow (ground covered to 100%). One month later winter barley was harvested and after a few light harrowings *Lolium perenne*, *Vicia sativa*, and *Trifolium incarnatum* ("Landsberger Gemenge") were sawn (RESCHENHOFER 1995). The same happened to the underseed (mainly *Trifolium pratense*) of the summer oat field after the harvest in mid of August.

RESULTS

11816 individuals of ground living spiders and 332 egg sacs (of lycosids) were recorded. 44 species were identified out of 7774 adults (Tab. 1). The most numerous were the Lycosidae with *Pardosa agrestis* (Westring, 1861), *P. palustris* (Linné, 1758), and the linyphiid *Oedothorax apicatus* (Blackwall, 1850) (Fig. 2 & Fig. 3). 31 of the recorded species fell below the 1% level of relative abundance. Beyond the spiders of the epigeic fauna species of higher strata like *Araneus diadematus* Clerck, 1757, *Argiope bruennichi* (Scopoli, 1772), *Nuctenea umbratica* (Clerck, 1757), *Larinioides folium* (Schrank, 1803), *Tetragnatha pinicola* L. Koch, 1870 as well as *Agelena gracilens* C. L. Koch, 1841 were often found but no specimen was recorded with the pitfall traps.

Species density was found to be similar not only in both sections but also within each of the three rows: 34 species (20.5 ± 3.2) at the edge close to summer oat, 35 (19.8 ± 2.3) in the center, and 31 (19.7 ± 1.9) at the edge close to winter barley. Spider activity showed a significant increase for all adults as well as for the Lycosidae from the edge close to spring oat to the edge close to winter barley (Fig. 4).

In particular males of the most abundant *P. agrestis* showed a considerable increase (Fig. 5). The males of *Oedothorax fuscus* as well as both sexes of *Pachygnatha clercki* tended to a higher activity at the edge close to winter barley. Most males of *Erigone dentipalpis* and *Pardosa palustris* as well as females of *P. agrestis*, immatures of *Trochosa* sp. (most probably all of them *T. ruricola*), and egg sacs of *Pardosa* spp. (mainly *P. agrestis*) were recorded in the center (significant differences compared with the edge close to spring oat: Mann-Whitney U-test: $p < 0.05$). No differences were found for the other species as well as within each of the sections in longitudinal direction.

DISCUSSION

The most abundant species are known to be photophilous and typical for fields as well as cultivated grasslands (e.g. HANGGI *et al.* 1995). Some of the species seem to be less characteristic for the pioneer status of the hedgerow. For instance, the linyphiids *Centromerus sylvaticus* (Blackwall, 1841), *Diplostyla concolor* (Wider, 1834), *Micrargus herbigradus* (Blackwall, 1854), and the lycosid *Pardosa lugubris*

TAB. 1

Spider species recorded in sections A and B of the hedgerow during the first year after plantation (April 1993 - January 1994; 18 pitfall traps). The number of adults, the sex ratio (if meaningful), and the levels of relative abundance > 1% are given.

				Adults	♂ ♀	Abundance
Dictynidae	*Dictyna*	*pusilla*	Thorell, 1856	1		x
Gnaphosidae	*Drassodes*	*pubescens*	(Thorell, 1856)	1		x
	Micaria	*pulicaria*	(Sundevall, 1832)	2		x
	Zelotes	*latreillei*	(Simon, 1878)	1		x
Hahniidae	*Hahnia*	*nava*	(Blackwall, 1841)	3		x
Linyphiidae - Erigoninae	*Araeoncus*	*humilis*	(Blackwall, 1841)	180	5.9 : 1	2.3
	Asthenargus	*helveticus*	Schenkel, 1936	1		x
	Dicymbium	*brevisetosum*	Locket, 1962	3		x
	Diplocephalus	*cristatus*	(Blackwall, 1833)	4		x
	Erigone	*atra*	Blackwall, 1833	527	15 : 1	6.8
		dentipalpis	(Wider, 1834)	367	8.7 : 1	4.7
	Micrargus	*herbigradus*	(Blackwall, 1854)	2		x
		subaequalis	(Westring, 1851)	2		x
	Oedothorax	*apicatus*	(Blackwall, 1850)	2111	1 : 1.4	27.2
		fuscus	(Blackwall, 1834)	88	1.3 : 1	1.1
	Pelecopsis	*parallela*	(Wider, 1834)	1		x
	Walckenaeria	*nudipalpis*	(Westring, 1851)	7		x
		vigilax	(Blackwall, 1853)	81	1 : 1.1	1.0
Linyphiidae - Linyphiinae	*Bathyphantes*	*gracilis*	(Blackwall, 1841)	3		x
	Centromerita	*bicolor*	(Blackwall, 1833)	155	18.4 : 1	2.0
	Centromerus	*sylvaticus*	(Blackwall, 1841)	9		x
	Diplostyla	*concolor*	(Wider, 1834)	5		x
	Leptyphantes	*tenuis*	(Blackwall, 1852)	4		x
	Meioneta	*rurestris*	(C. L. Koch, 1836)	60	3 : 1	x
	Microlinyphia	*pusilla*	(Sundevall, 1830)	3		x
	Porrhomma	*microphthalmum*	(O. P.-Cambridge, 1871)	23	1.1 : 1	x
		oblitum	(O. P.-Cambridge, 1870)	12	5 : 1	x
Lycosidae	*Alopecosa*	*pulverulenta*	(Clerck, 1757)	11	no ♀	x
	Aulonia	*albimana*	(Walckenaer, 1805)	1		x
	Pardosa	*agrestis*	(Westring, 1861)	2357	2.7 : 1	30.3
		hugubris s.l.	(Walckenaer, 1802)	1		x
		palustris	(Linne, 1758)	806	3.9 : 1	10.4
		prativaga	(L. Koch, 1870)	2		x
		pullata	(Clerck, 1757)	12	no ♀	x
	Pirata	*latitans*	(Blackwall, 1841)	4		x
	Trochosa	*ruricola*	(de Geer, 1778)	282	6.2 : 1	3.6
		terricola	Thorell, 1856	1		x
Salticidae	*Phlegra*	*fasciata*	(Hahn, 1826)	1		x
Tetragnathidae	*Pachygnatha*	*clercki*	Sundevall, 1823	148	1.4 : 1	1.9
		degeeri	Sundevall, 1830	354	1 : 1.1	4.6
Theridiidae	*Achaearanea*	*riparia*	(Blackwall, 1834)	3		x
	Robertus	*neglectus*	(O. P.-Cambridge, 1871)	11	no ♀	x
	Theridion	*impressum*	L. Koch, 1881	1		x
Thomisidae	*Xysticus*	*kochi*	Thorell, 1872	122	14.3 : 1	1.6

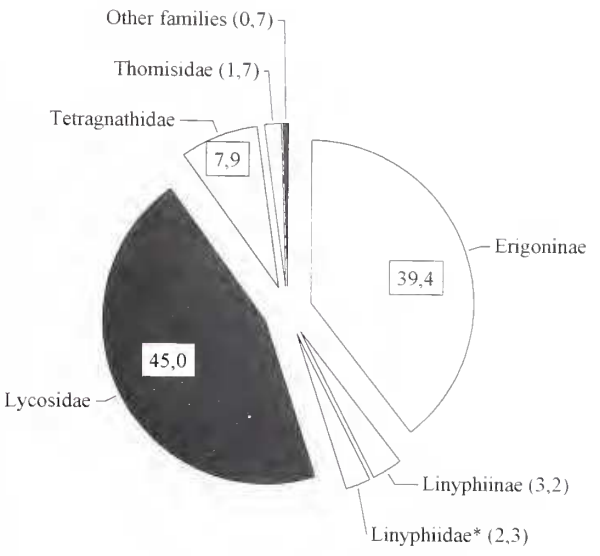

FIG. 2

Percentages of all individuals representing each of the spider families trapped (young brood of lycosids excluded); *) not classified immature/juvenile linyphiids.

s.l. (Walckenaer, 1802) are known to be common in mature hedges and field shrubs as well as along the edges of woods in Central Europe (TISCHLER 1958; BEYER 1978; BLICK 1988, 1990, 1991; BLICK & BLISS 1993; STEINBERGER & KROMP 1993). Further investigations will show whether they remain and increase in number.

The record of the theridiid *Achaearanea riparia* (Blackwall, 1834) and the linyphiid *Asthenargus helveticus* Schenkel, 1936 should be stressed, though only few individuals were trapped. However, both species are rarely found in general (e.g. HÄNGGI *et al.* 1995). FREUDENTHALER (1989) recorded three males of *A. helveticus* in a peat-bog in Upper Austria and connects the findings with the climatic conditions similar to those of montane areas. Anyway, this species is known to occur mainly in moisty habitats. Though *A. riparia* seems to occur mostly in fields it has not been found often before.

Most individuals spread out from the winter barley field into the hedgerow. No wonder, if one considers that this field was the only vegetated area during the winter as well as the early spring and that relatively small differences in habitat structure may have a significant effect on the numbers and species of spiders (DUFFEY 1978; HATLEY & MACMAHON 1980; ROBINSON 1981; SCHEIDLER 1990; MOREBY *et al.* 1994). ALDERWEIRELDT (1994) and LYS & NENTWIG (1994) showed this by manipulating habitats in agroecosystems.

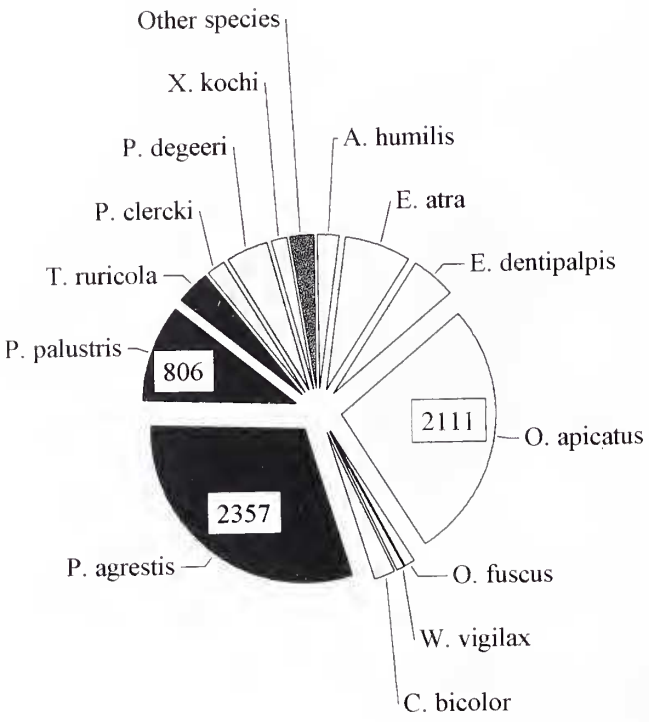

FIG. 3

Numbers of adults representing each of the spider species that come up to > 1% of relative abundance; only numbers of the most abundant species are shown.

The high percentage of lycosids is surprising, because they are supposed to be more susceptible to mechanical disturbances than linyphiids (TISCHLER 1965), which should be in preponderance in cereal fields (TISCHLER 1958; THALER *et al.* 1977; LUCZAK 1979; SUNDERLAND 1987; TOFT 1989; NYFFELER & BREENE 1992; LYS & NENTWIG 1994; WHITE & HASSALL 1994; DINTER 1995). Even though the current data must not be brought in direct relation to the others, a hint is given, that the spider fauna within the hedgerow already differed from those of the adjacent cultivations, though no results on the spider compositions of the two adjacent fields are present. Nevertheless I dare to state that the successional hedgerow already provided conditions in regard of vegetation structure, microclimate and food availability, which were different from those of the cereal fields. Thus it might have been an important refuge for the spider species with susceptible life stages at the time of the year with most agricultural disturbances as it was especially in spring and in the spring oat field; and in particular lycosids were favoured. Results of further investigations will possibly give an insight into this and other questions concerning the succession within this pioneer habitat.

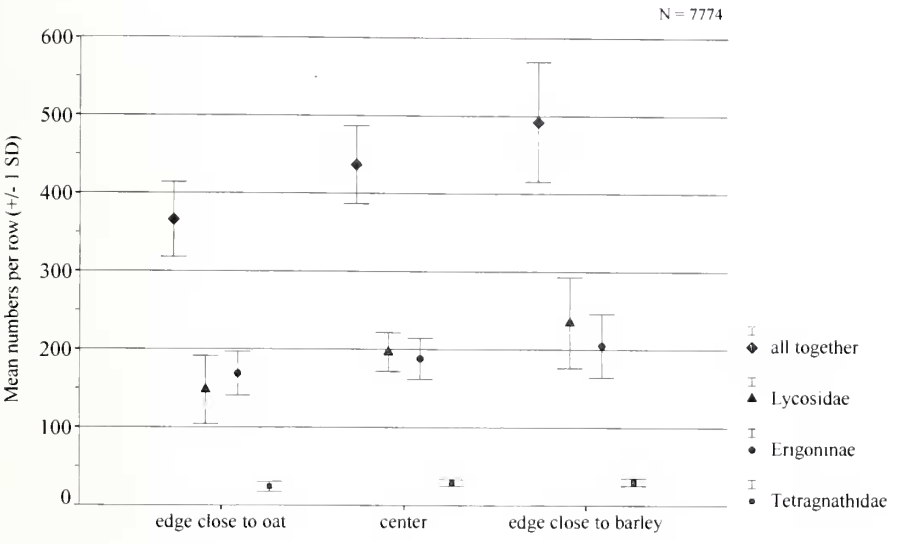

FIG. 4 - Distribution patterns of the adult spiders. Significant differences (Kruskal-Wallis H-test: $p < 0.05$) in increase of numbers were found for all adults together as well as for the Lycosidae. However, no significant results were given for the Erigoninae and Tetragnathidae. Linyphiinae and Thomisidae are not shown.

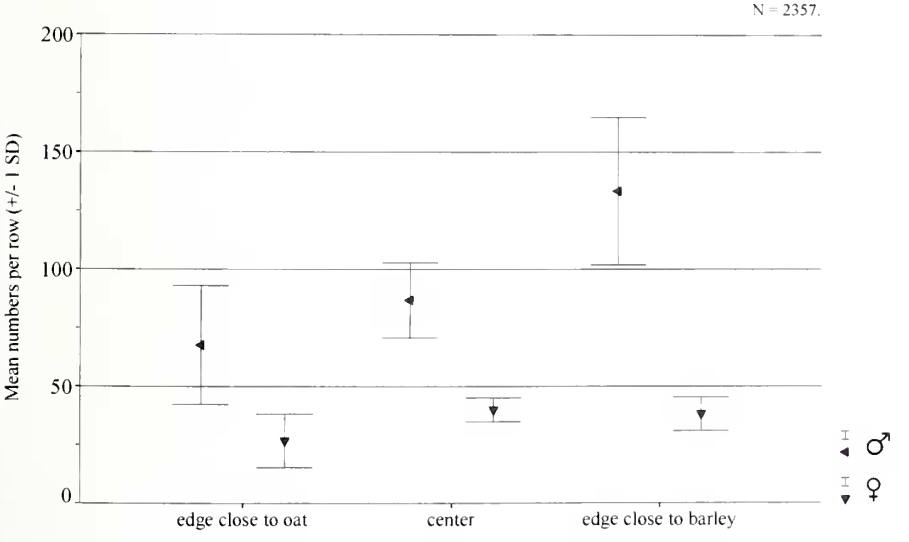

FIG. 5 - Distribution pattern of *Pardosa agrestis*. Significant differences (Kruskal-Wallis H-test: $p < 0.01$) were found for the males: The numbers increased from the edge close to spring oat to the edge close to winter barley. Significant differences for females were only given between the edge close to oat and the center (Mann-Whitney U-test: $p < 0.05$).

ACKNOWLEDGEMENTS

I express my thanks to theland-owners Mag. rer. nat. Johann & Judith Reschenhofer (Schwand im Innkreis) for their friendly co-operation and hospitality. Thanks also go to Dipl.-Biol. Theo Blick (Bayreuth) for his continuous support and to UD Dr Konrad Thaler (Inssbruck) for introducing me to the determination of spiders and for checking specimens, which made difficulties. I am also grateful to Ao. Prof. Dr Kurt Pohlhammer and Dr Karl Treihlmayr for good advices and their instructions for theuse of institutional equipements. Finally I want to thank the anonymous reviewers.

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